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Petroleum and natural gas industries — Floating offshore structures —

Part 1: Monohulls, semi-submersibles and spars

Industries du pétrole et du gaz naturel — Structures en mer flottantes — Partie 1: Unités monocoques, unités semi-submersibles et unités spars

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 19904-1 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 7, *Offshore structures*.

ISO 19904 consists of the following parts, under the general title *Petroleum and natural gas industries — Floating offshore structures*:

— *Part 1: Monohulls, semi-submersibles and spars*

Tension leg platforms is to form the subject of a future *Part 2*.

ISO 19904 is one of a series of standards for offshore structures. The full series consists of the following International Standards.

— ISO 19900, *Petroleum and natural gas industries — General requirements for offshore structures*

— ISO 19901 (all parts), *Petroleum and natural gas industries — Specific requirements for offshore structures*

— ISO 19902, *Petroleum and natural gas industries — Fixed steel offshore structures* [1)]

— ISO 19903, *Petroleum and natural gas industries — Fixed concrete offshore structures* [1)]

— ISO 19904-1, *Petroleum and natural gas industries — Floating offshore structures — Part 1: Monohulls, semi-submersibles and spars*

— ISO 19904-2, *Petroleum and natural gas industries — Floating offshore structures — Part 2: Tension leg platforms* [2)]

— ISO 19905-1, *Petroleum and natural gas industries — Site-specific assessment of mobile offshore units — Part 1: Jack-ups* [2)]

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1) To be published.

2) Under preparation.

— ISO/TR 19905-2, *Petroleum and natural gas industries — Site-specific assessment of mobile offshore units — Part 2: Jack-ups commentary* [3)]

— ISO 19906, *Petroleum and natural gas industries — Arctic offshore structures* [3)]

3) Under preparation.

Introduction

The series of International Standards applicable to types of offshore structure, ISO 19900 to ISO 19906, constitutes a common basis covering those aspects that address design requirements and assessments of all offshore structures used by the petroleum, petrochemical and natural gas industries worldwide. Through their application the intention is to achieve reliability levels appropriate for manned and unmanned offshore structures, whatever the type of structure and the nature or combination of materials used.

It is important to recognize that structural integrity is an overall concept comprising models for describing actions, structural analyses, design rules, safety elements, workmanship, quality control procedures and national requirements, all of which are mutually dependent. The modification of one aspect of design in isolation can disturb the balance of reliability inherent in the overall concept or structural system. The implications involved in modifications, therefore, need to be considered in relation to the overall reliability of all offshore structural systems.

The series of International Standards applicable to types of offshore structure is intended to provide wide latitude in the choice of structural configurations, materials and techniques without hindering innovation. Sound engineering judgement is therefore necessary in the use of these International Standards.

International Standard ISO 19904 was developed in response to the offshore industry's demand for a coherent and consistent definition of methodologies to design, analyse and assess floating offshore structures of the class described in Clause 1. In particular, this part of ISO 19904 addresses monohulls, semi-submersibles and spars.

Some background to, and guidance on, the use of this part of ISO 19904 is provided in informative Annex A. The clause numbering in Annex A is the same as in the normative text to facilitate cross-referencing.

Petroleum and natural gas industries — Floating offshore structures —

Part 1: Monohulls, semi-submersibles and spars

1 Scope

This part of ISO 19904 provides requirements and guidance for the structural design and/or assessment of floating offshore platforms used by the petroleum and natural gas industries to support the following functions:

— production;

— storage and/or offloading;

— drilling and production;

— production, storage and offloading;

— drilling, production, storage and offloading.

NOTE 1 Floating offshore platforms are often referred to using a variety of abbreviations, e.g. FPS, FSU, FPSO, etc. (see Clauses 3 and 4), in accordance with their intended mission.

NOTE 2 In this part of ISO 19904, the term "floating structure", sometimes shortened to "structure", is used as a generic term to indicate the structural systems of any member of the classes of platforms defined above.

NOTE 3 In some cases, floating platforms are designated as "early production platforms". This term relates merely to an asset development strategy. For the purposes of this International Standard, the term "production" includes "early production".

Its requirements do not apply to the structural systems of mobile offshore units (MOUs). These include, among others:

— floating structures intended primarily to perform drilling and/or well intervention operations (often referred to as MODUs), even when used for extended well test operations;

— floating structures used for offshore construction operations (e.g. crane barges or pipelay barges), for temporary or permanent offshore living quarters (floatels), or for transport of equipment or products (e.g. transportation barges, cargo barges), for which structures reference is made to relevant recognized classification society (RCS) rules.

Its requirements are applicable to all possible life-cycle stages of the structures defined above, such as

— design, construction and installation of new structures, including requirements for inspection, integrity management and future removal,

— structural integrity management covering inspection and assessment of structures in-service, and

— conversion of structures for different use (e.g. a tanker converted to a production platform) or reuse at different locations.

The following types of floating structure are explicitly considered within the context of this part of ISO 19904:

a) monohulls (ship-shaped structures and barges);

b) semi-submersibles;

c) spars.

In addition to the structural types listed above, this part of ISO 19904 covers other floating platforms intended to perform the above functions, consisting of partially submerged buoyant hulls made up of any combination of plated and space frame components and used in conjunction with the stationkeeping systems covered in ISO 19901-7. These other structures can have a great range of variability in geometry and structural forms and, therefore, can be only partly covered by the requirements of this part of ISO 19904. In other cases, specific requirements stated in this part of ISO 19904 can be found not to apply to all or part of a structure under design.

In all the above cases, conformity with this part of ISO 19904 will require that the design is based upon its underpinning principles and achieves a level of safety equivalent, or superior, to the level implicit in it.

NOTE 4 The speed of evolution of offshore technology often far exceeds the pace at which the industry achieves substantial agreement on innovation in structural concepts, structural shapes or forms, structural components and associated analysis and design practices, which are continuously refined and enhanced. On the other hand, International Standards can only capture explicit industry consensus, which requires maturation and acceptance of new ideas. Consequently, advanced structural concepts can, in some cases, only be partly covered by the provisions of this part of ISO 19904.

This part of ISO 19904 is applicable to steel floating structures. The principles documented herein are, however, considered to be generally applicable to structures fabricated in materials other than steel.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 13702, *Petroleum and natural gas industries — Control and mitigation of fires and explosions on offshore production installations — Requirements and guidelines*

ISO 19900:2002, *Petroleum and natural gas industries — General requirements for offshore structures*

ISO 19901-1, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 1: Metocean design and operating considerations*

ISO 19901-7:2005, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 7: Stationkeeping systems for floating offshore structures and mobile offshore units*

ISO 19902:—[4], *Petroleum and natural gas industries — Fixed steel offshore structures*

[4] To be published.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
abnormal
condition that exceeds conventionally specified design conditions and which is used to mitigate against very remote events

3.2
accidental design situation
design situation involving exceptional conditions of the structure or its exposure

EXAMPLE Impact, fire, explosion, local failure or loss of intended differential pressure (e.g. buoyancy).

3.3
action
external load applied to the structure (direct action) or an imposed deformation or acceleration (indirect action)

EXAMPLE An imposed deformation can be caused by fabrication tolerances, settlement, temperature change or moisture variation.

NOTE An earthquake typically generates imposed accelerations.

[ISO 19900:2002]

3.4
action combination
design values of different actions considered simultaneously in design checks of the structure for a specific limit state

3.5
action effect
effect of actions on structural components

EXAMPLE Internal forces, moments, stresses, strains, rigid body motions or elastic deformations.

[ISO 19900:2002]

3.6
air gap
clearance between the highest water surface that occurs during the extreme environmental conditions and the lowest exposed part not designed to withstand wave impingement

[ISO 19900:2002]

3.7
basic variable
one of a specified set of variables representing physical quantities which characterize actions, environmental influences, geometrical quantities, or material properties, including soil properties

[ISO 19900:2002]

3.8
characteristic value
value of a basic variable, an action or a strength model having a prescribed probablilty of not being violated by unfavorable values

NOTE 1 In the case of actions and related properties, the characteristic value normally relates to a reference period.

NOTE 2 Adapted from ISO 19900:2002, definition 2.7.

3.9
design criteria
quantitative formulations that describe the conditions to be fulfilled for each limit state

[ISO 19900:2002]

3.10
design format
mathematical description for checks to verify non-exceedance of a limit state

NOTE In this part of ISO 19904, both partial factor and working stress design (WSD) formats are permitted.

3.11
design service life
assumed period for which a structure or a structural component is to be used for its intended purpose with anticipated maintenance, but without substantial repair being necessary

NOTE Adapted from ISO 19900:2002, definition 2.12.

3.12
design situation
set of physical conditions during a certain reference period for which the design demonstrates that relevant limit states are not exceeded

NOTE Adapted from ISO 19900:2002, definition 2.13.

3.13
design value
value of a basic variable, action or strength model derived from a representative value for use in a design verification procedure

NOTE 1 For a ULS design check in accordance with the partial factor design format, a design value for a strength variable or model is found by dividing the representative value of strength by a partial resistance factor, while for an action variable it is found by multiplying the representative value of the action effect by a partial action factor.

NOTE 2 For an FLS, SLS or ALS design check in accordance with the partial factor design format, all partial factors are equal to unity so that, in these cases, a design value is equal to the representative value.

NOTE 3 For any design check in accordance with the working stress design format, all partial factors are equal to unity so that, in these cases, a design value is equal to the representative value. Appropriate global safety or utilization factors are applied in design checks.

NOTE 4 In the case of actions and related properties, the value can relate to a reference period.

NOTE 5 Adapted from ISO 19900:2002, definition 2.14.

3.14
dynamic action
action that induces acceleration of a structure or a structural component of a magnitude sufficient to require specific consideration

[ISO 19901-7:2005]

3.15
dynamic positioning
DP
stationkeeping technique consisting primarily of a system of on-board thrusters, which generate appropriate thrust vectors to counter the mean and slowly varying induced actions

3.16
exposure level
classification system used to define the requirements for a structure based on consideration of life-safety and of environmental and economic consequences of failure

[ISO 19900:2002]

3.17
failure
insufficient strength or inadequate serviceability of a structure or structural component, or, in a structural check, a condition in which a structure or component thereof does not fulfil its limit state requirement

3.18
fit-for-purpose, adjective
fitness-for-purpose, noun
meeting the intent of a standard although not meeting specific provisions of that standard in local areas, such that failure in these areas cannot cause unacceptable risk to life-safety or the environment

NOTE Adapted from ISO 19900:2002, definition 2.16.

3.19
floating structure
structure where the full weight is supported by buoyancy

[ISO 19900:2002]

NOTE The full weight includes lightship weight, mooring system pre-tension, riser pre-tension and operating weight.

3.20
freeboard
distance measured vertically downwards between the top of the hull and the mean water surface at a given draught

3.21
green water
overtopping of deck by water causing slamming and pressure actions to structures on deck

3.22
limit state
state beyond which the structure no longer fulfils the relevant design criteria

[ISO 19900:2002]

3.23
mobile offshore drilling unit
MODU
structure capable of engaging in drilling and well intervention operations for exploration or exploitation of subsea petroleum resources

[ISO 19901-7:2005]

3.24
mobile offshore unit
MOU
structure intended to be relocated to perform a particular function

[ISO 19900:2002]

3.25
monohull
floating structure consisting of a single, continuous, buoyant hull, and having a geometry similar to that of ocean-going ships, barges, etc.

3.26
nominal value
value of a basic variable, action or strength model determined on a non-statistical basis, typically from acquired experience or physical conditions

EXAMPLE Value published in a recognized code or standard.

NOTE Adapted from ISO 19900:2002, definition 2.22.

3.27
owner
representative of the company or companies which own a development, who can be the operator on behalf of co-licensees

[ISO 19901-7:2005]

3.28
platform
complete assembly including structure, topsides and, where applicable, foundations and stationkeeping system

NOTE Adapted from ISO 19900:2002, definition 2.23.

3.29
recognized classification society
RCS

member of the international association of classification societies (IACS), with recognized and relevant competence and experience in floating structures, and with established rules and procedures for classification/certification of installations used in petroleum or natural gas activities, located at a specific site for an extended period of time

NOTE Adapted from ISO 19901-7:2005, definition 3.23.

3.30
reliability
ability of a structure or structural component to fulfil the specified requirements

[ISO 19900:2002]

3.31
representative value
value of a basic variable, action or strength model, for verification of a limit state

NOTE 1 The representative value can equal a characteristic value, a nominal value, or other rationally determined value.

NOTE 2 For actions, this can relate to upper or lower characteristic values, dependent on which causes the more onerous condition. In combinations, it can involve multiplying the chosen value by a factor greater or less than unity.

NOTE 3 Adapted from ISO 19900:2002, definition 2.26.

3.32
resistance
capacity of a structure, component or cross-section of a component to withstand action effects without exceeding a limit state

NOTE Adapted from ISO 19900:2002, definition 2.27.

3.33
return period
average period between occurrences of an event or of a particular value being exceeded

NOTE The offshore industry commonly uses a return period measured in years for environmental events. The return period in years is equal to the reciprocal of the annual probability of exceedance of the event.

[ISO 19901-1:2005]

3.34
riser
piping connecting the process facilities or drilling equipment on the floating structure with the subsea facilities or pipelines, or with a reservoir

NOTE 1 Possible functions include drilling and well intervention, production, injection, subsea systems control and export of produced fluids.

NOTE 2 Adapted from ISO 19900:2002, definition 2.29.

3.35
robustness
ability of a structure to withstand events that have a reasonable likelihood of occurring, without the structure being damaged to an extent disproportionate to the cause

NOTE Possible causes can be events like fire, explosions or impacts.

3.36
semi-submersible
floating structure normally consisting of a deck structure with a number of widely spaced, large cross-section, supporting columns connected to submerged pontoons

NOTE Pontoon/column geometry is usually chosen to minimize global motions in a broad range of wave frequencies.

3.37
slamming
impulsive action with high pressure peaks that occurs during impact between a portion of the structure and water

NOTE Slamming can, for example, be due to emergence and re-entry of a lower section of the hull into the water or can be due to wave impact on a structural component.

3.38
sloshing
impact action on the boundaries of a partially filled tank due to internal fluid motion

3.39
spar platform
spar
deep draught caisson vessel
DDCV
deep-draught, small water-plane area floating structure

[ISO 19901-7:2005]